TRAVAUX DU MUSÉUM NATIONAL D'HISTOIRE NATURELLE «GRIGORE ANTIPA»

THE JOURNAL OF "GRIGORE ANTIPA" NATIONAL MUSEUM OF NATURAL HISTORY

Travaux du Muséum National d'Histoire Naturelle "Grigore Antipa" 66 (2): 337–354 (2023)
doi: 10.3897/travaux.66.e115815

RESEARCH ARTICLE

Preliminary data on the diet composition and nesting behaviour of the Long-legged Buzzard (*Buteo rufinus*) in south-western Romania

Alexandru Cătălin Birău[1], Marian Tudor[2], Dumitru Murariu[3], Andreea-Cătălina Drăghici[1, 4]

1 *University of Bucharest, Faculty of Biology, Splaiul Independenței 91–95, Bucharest, R-050095, Romania*

2 *University Ovidius Constanta, Faculty of Natural Sciences and Agricultural Sciences, Al. Universitații 1, Corp B, 900470, Constanța, Romania*

3 *Institute of Biology Bucharest, Romanian Academy, 296 Splaiul Independenței, Bucharest, Romania*

4 *Grigore Antipa National Museum of Natural History, Șos. Kiseleff Nr. 1, 011341 Bucharest, Romania*

Corresponding author: *Alexandru Cătălin Birău* (birau.alexandru-catalin@s.bio.unibuc.ro)

Received 15 November 2023 | Accepted 9 December 2023 | Published 31 December 2023

Citation: Birău AC, Tudor M, Murariu D, Drăghici A-C (2023) Preliminary data on the diet composition and nesting behaviour of the Long-legged Buzzard (*Buteo rufinus*) in south-western Romania. Travaux du Muséum National d'Histoire Naturelle "Grigore Antipa" 66(2): 337–354. https://doi.org/10.3897/travaux.66.e115815

Abstract

The study of a nest of Long-legged Buzzard *Buteo rufinus* was carried out using a trail camera and is one piece of a completely unknown jigsaw puzzle of diet and nesting behaviour in Romania. With a hatching success of 75%, we identified 3 hatched chicks from the 4 eggs. During the 10 days of monitoring, 34 preys brought to the nest were identified, with a peak of activity between 11:00–17:00 and a preference for the European Ground Squirrel *Spermophilus citellus* (61.76%). This was followed by the Domestic Pigeon *Columba livia* f. *domestica* and the Common Wood Pigeon *C. palumbus* (5.88%), and amphibians were represented by the European Green Toad *Bufotes viridis* (2.94%). There were 10 unidentified prey species (29.41%). We identified the presence of plastic and textile fibres in the nest and the risk of chick suffocation. We also improved our understanding of interspecific interactions and our observations highlighted the mutualism between the three species in the nest: Spanish Sparrow, House Sparrow and LLB. The removal of solitary trees from the agricultural landscape is a major threat in south-western Romania, affecting the breeding population of the LLB, which, as in our case, nests on this type of support.

Keywords

Long-legged Buzzard, trail camera, diet, foraging, breeding behaviour, south-western Romania.

Introduction

Accurate knowledge of a species' diet is needed for a more complete understanding of its feeding ecology (Bakaloudis 2009, 2010; Birrer 2010) and habitat requirements as well as to manage and protect species (Oehm et al. 2011; Gong et al. 2019). The breeding success is mostly controlled by the abundance and type of food resources as well as by the availability of suitable nesting sites (Newton 1979, 1988; Jenkins 1994; Watson 1997; Wightman 2001). Therefore, the diet is an imperative information in order to determine ecological function and conservation management (Wang et al. 2022).

The Long-legged Buzzard (*Buteo rufinus*), hereafter LLB, has a large range from N Africa, Europe from Hungary to the Balkans, Ukraine and S Russia, and Asia from Turkey through Transcaucasia, Iran, Afghanistan to and Central Asia to NW China, and S to N Pakistan and NW India (Snow and Perrins 1998; Stoychev and Demerdzhiev 2020; Friedemann et al. 2021). The population of LLB in Europe is increasing, currently estimated between 11,800 and 19,200 pairs, more than 85% of which are found in Russia, Turkey, Azerbaijan, Bulgaria and Romania (Stoychev and Demerdzhiev 2020). The distribution of the LLB seems to overlap with that of the European Ground Squirrel (*Spermophilus citellus*) (Tucker and Heath 1994). Also, the population of LLB is thought to fluctuate in response to voles populations (Ferguson-Lees and Christie 2001). Mrlík and Landsfeld (2002) considered food as a factor of less importance in the range expansion, reporting global warming and the expansion of pseudo-steppes as a consequence. The LLB inhabits predominantly in open natural or intensively cultivated areas (Shirihai 1996; Adamian and Klem 1999), with trees (singly or in groups) and on rocks near open feeding sites (Tucker and Heath 1994; Ferguson-Lees and Christie 2001). Included within their territories a village outskirts but almost no urban areas indicating the importance of open areas for foraging purposes for the species (Iezekiel et al. 2016).

The LLB´s diet consists mainly on small mammals, mostly Gound Squirrels (*Spermophilus sp.)*, rats (*Rattus* sp.), voles (*Microtus* sp.), young rabbits (*Oryctolagus cuniculus*), occasionally small hares (*Lepus europaeus)*, hamsters (*Cricetus cricetus*), hedgehogs (*Erinaceus roumanicus*), moles (*Talpa* sp.), and weasels (*Mustela* sp.); frogs and toads (*Rana* sp., *Pelobates* sp., and *Bufo* sp.); reptiles, as lizards (*Lacerta* sp., *Eremias* sp.) and snakes (*Natrix* sp., *Vipera* sp.); a low number of birds whose size vary from larks (*Alaudidae*) to female common pheasant (*Phasianus colchicus*) and short-eared owl (*Asio flammeus*) or large insects in spring, summer, and autumn (Coleoptera and Orthoptera) because is an opportunistic raptor (Ali and Ripley 1968; Cramp and Simmons 1980, del Hoyo et al. 1994; Alivizatos and Goutner 1997; Khaleghizadeh et al. 2005; Mebs and Schmidt 2006; Wu et al. 2008; Friedemann et al. 2010; Dravecký et al. 2022).

The present study is the first in Romania to use a non-invasive method of data collection through photographic and digital image recording of LLB. Our work aimed to improve our knowledge of diet composition and to collect additional data

on feeding times and factors influencing diet in LLB from south-western Romania. Our observations on diet and breeding behaviour are collected from the first days of life, along with the ten days that are crucial for proper nestling development, unlike most studies that focus on the period immediately before leaving the nest. In addition, we show how knowledge of diet and chick development could help implement management strategies for species conservation.

Material and methods

Studied species

Over the past 20 years, the LLB has been expanding in Romania. (Daróczi and Zeitz 2008; Danko 2012; Baltag et al. 2014; Birău et al. 2018; Stoychev and Demerdzhiev 2020; Birău et al. - in preg). The LLB is currently distributed almost throughout the whole territory of Romania and is estimated at 400–900 breeding pairs (Fântână et al. 2022). Nest location is not only limited to cliffs, but trees are occasionally used (Cramp and Simmons 1980; Paz 1986, Shirihai 1996, Friedemann et al. 2010; Mansoori 2013) with oak and poplar most important species to place nests (Graham 1992), but also power-transmission poles (Milchev 2009). The species also seem to exhibit plasticity in their breeding habits (Iezekiel et al 2016).

Study area

This study was carried out in the south-western part of Romania in the Danube floodplain. The study area is located in Dolj County, 3 km from the Danube, with lowland intensively cultivated areas and isolated trees (Fig. 1), but also with grasslands where the European Ground Squirrel is present. The climate of this area is transitional between Temperate and Mediterranean. There is a village nearby, but the human impact on the nest is minimal.

Data collection and analyses

The first field visits to the surveyed nest took place on 13 March 2022. The nest site was examined with binoculars and the location was recorded with GPS. The distance between the monitored nest and the nearest road, calculated by using Google Earth, was 180 m. The nest was located in an old, isolated pedunculate oak (*Quercus robur* L.) surrounded by arable land, with agricultural roads between them, where the European Ground Squirrel has taken refuge in the absence of grassland. The nest was located at an altitude of 6 m and measured 63 centimeters in height, 61×74 centimeters in width, a structure with evidence of stratification, suggesting use over several years (Fig. 3). Food and nesting behaviour were recorded with a Minox trail 650 DTC camera over 10 days, from 21 May to 30 May 2022, following raptor diet assessment techniques (Newton 1990). Incubation began on 12 April with 4 eggs and was observed throughout the breeding season, during the post-hatching period (around the age of 10 days after hatching) and the chick-rearing period (around

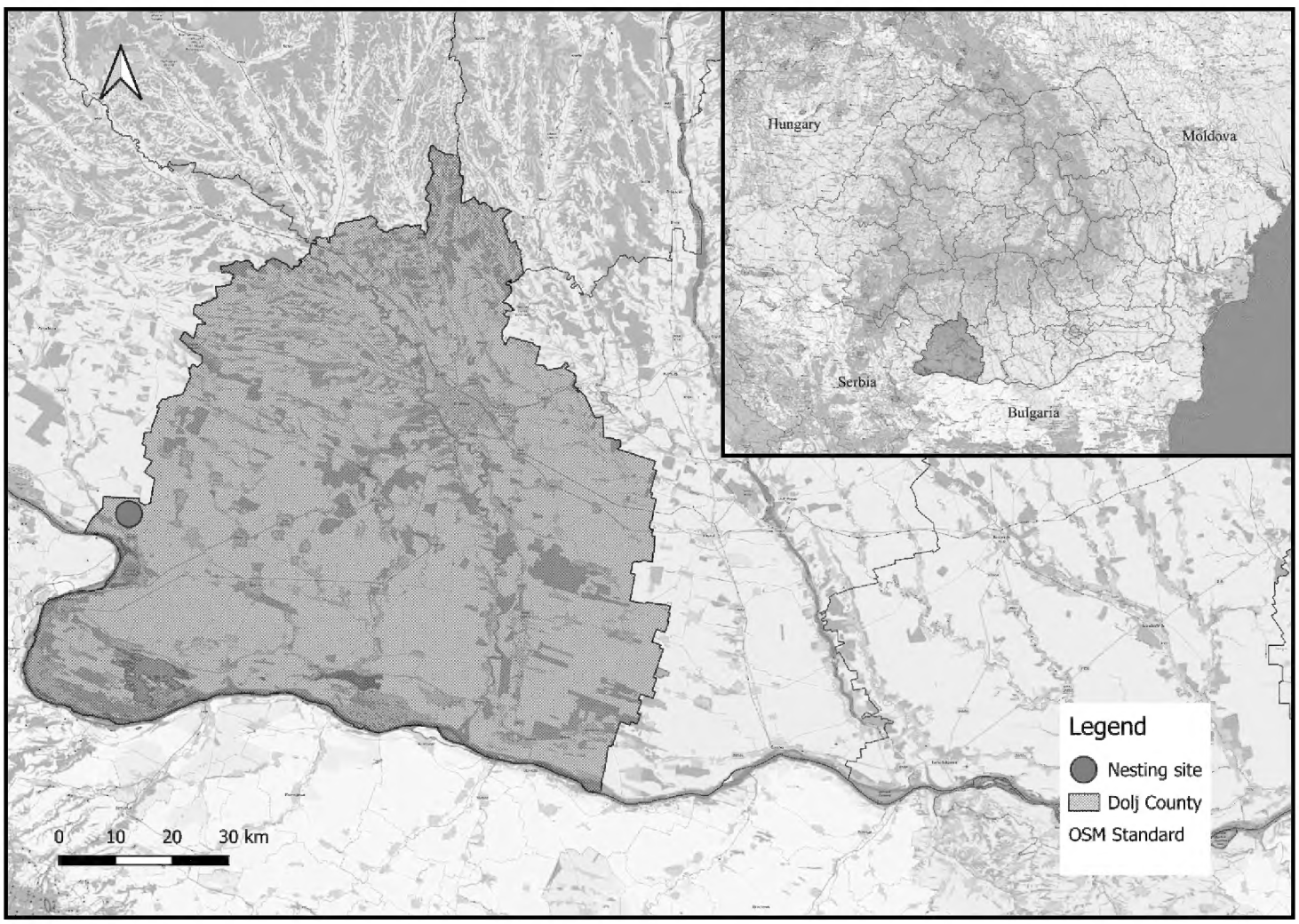

Figure 1. The nesting site of *Buteo rufinus* in Dolj county (red dot).

the age of 20 days after hatching) (Fig 4). Our study pair of LLB managed to hatch 3 chicks from 4 eggs, the first chick appeared on 12 May, and the trail camera was mounted and adjusted towards the nest on the 10th day of the first clutch to minimize disturbance (Fig. 6).

Figure 2. The study area with isolated pedunculate oaks (*Quercus robur* L.) and an open area with farming. Only one of the five oak trees presented LLB's nest (left) being also the one monitored.

Figure 3. Measurements of the monitored nest. The presence of plastic and textile materials in the nest is common at this species.

Figure 4. Clutch size with 4 eggs in the monitored nest.

Figure 5. The presence of plastic and textile fibres in the nest and the impact of chicks.

Figure 6. Hatching success in the monitored nest.

A classical exploratory approach was preferred for the analysis of the collected data. The main factors analyzed were the frequency and composition of prey and also the share of different prey categories in the total prey fed to the chicks.

Results

Of the 11,760 photographs taken during the monitoring, we identified 34 prey items of LLB (Fig. 8). We analyzed the feeding period defined as the time between 06:00 and 20:00 when the first and last feeding took place. Thus, we outline 3 feeding periods: 06.00–10.00, 11.00–17.00, and 18.00–20.00. This shows that the diet was dominated by one mammal species, the European Ground Squirrel (61.76%), followed by birds represented by two species, the Domestic Pigeon *Columba livia* f. *domestica* and the Common Wood Pigeon *C. palumbus* (5.88%). Amphibians were represented by only one specimen of the European Green Toad *Bufotes viridis* (2.94%) (Fig. 12). There were 10 unidentified prey items (29.41%). There were also 2 feeding pauses, between 10–11 and 17–18 (Fig. 7).

During the monitoring, the chicks were fed by the female and the male was only present when bringing the prey (see Fig. 9). The female remained with the chicks throughout the monitoring, with short intervals of absence, and also protected the chicks during the rain that occurred on the 7th day (see Fig. 14).

The 34 prey items brought to the nest accounted for 37 feedings, as 2 prey items of pigeon species were multiple meals. Domestic Pigeon was hunted and brought to the nest in the morning of the 2nd day, where part of it was eaten, and the other part

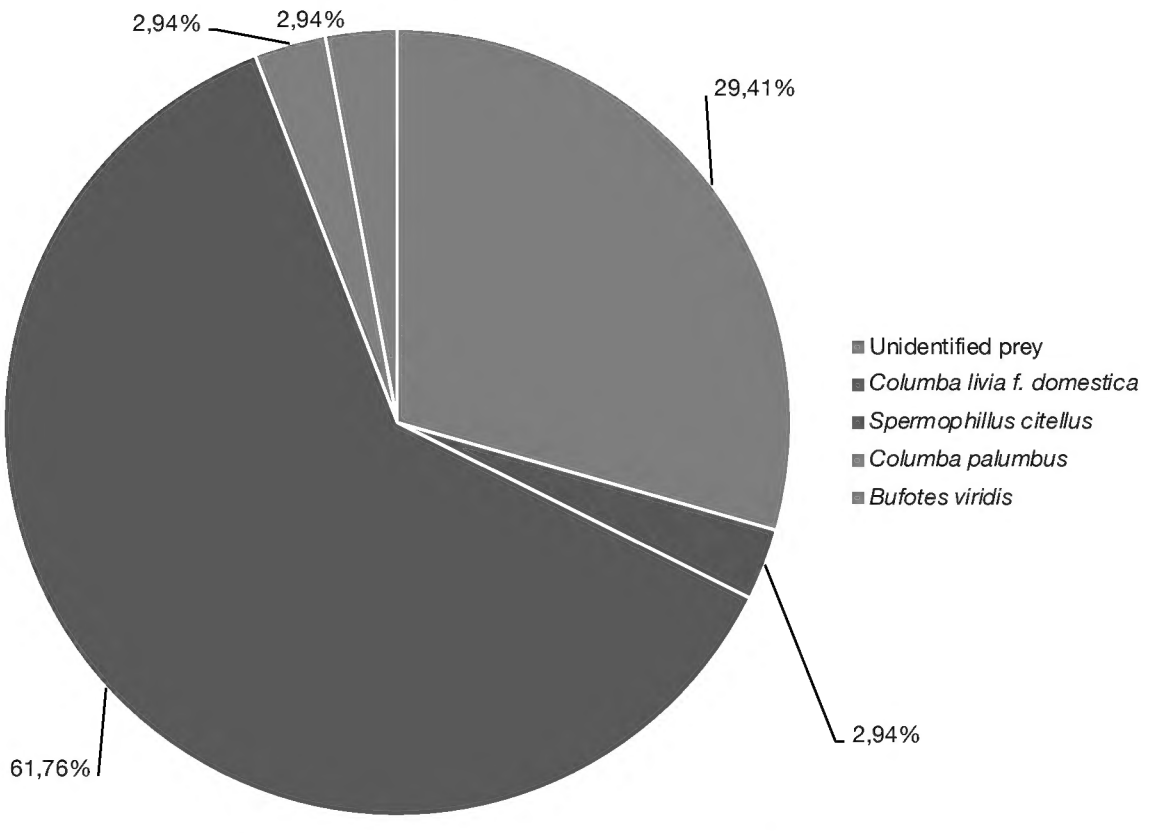

Figure 7. Prey composition during the study.

consumed in the afternoon of the same day. The Common Wood Pigeon, hunted on the 5th day, was eaten in three meals: when it was brought to the nest, then in the evening of the same day, and the third meal was the following morning, on the 6th day of observation (Fig. 11). We observed an increase in the number of prey brought to the nest on days 9 and 10, when we recorded 7 and 6 prey per day, respectively. We observed the presence of the European Ground Squirrel in the diet on 9 out of the 10 days of study, with an average of 2.3 per day. On day 4 of the monitoring, i.e. their 14th day of life, LLB chicks were also observed to ingest whole prey of *S. citellus* (Figs 9, 10). The earliest feeding occurred at 06:02 on monitoring day 6, facilitated by the presence of food left over from the previous day, the remainder being from the Common Wood Pigeon (*C. palumbus*). The last feeding occurred at 20:34 on monitoring day 5, again facilitated by the presence of prey stored in the nest, the same Common Wood Pigeon that was hunted on monitoring day 5 at 16:04, which constituted 3 meals. We can therefore see that the food stores provide multiple food sources at times when the chicks would not otherwise have been fed. No nocturnal feeding was observed.

The hatching success recorded in our study was 75%, hatching 3 out of 4 eggs. The chicks did not hatch at the same time, one of them being smaller in size (Fig. 6). The nest was constantly renewed with plant material such as twigs of the pedunculate oak (*Q. robur* L.) in which it was located or leaves of maize (*Zea mays*) from extensive agricultural plots found near the nest (See Fig. 10). The presence of plastic and textiles in the nest was also observed. The female apparently used these to increase the thermal comfort of the chicks. An imminent danger of suffocation for a chick was also recorded on the 2nd day of the monitoring (Figs 5, 13).

Eighteen pairs of Spanish Sparrow (*Passer hispaniolensis*) (Fig. 15) and one pair of the House Sparrow (*P. domesticus*) (Fig. 16) were observed in the same pedunculate oak. The nest of the House Sparrow and three nests of the Spanish Sparrow were built at the base of the LLB nest.

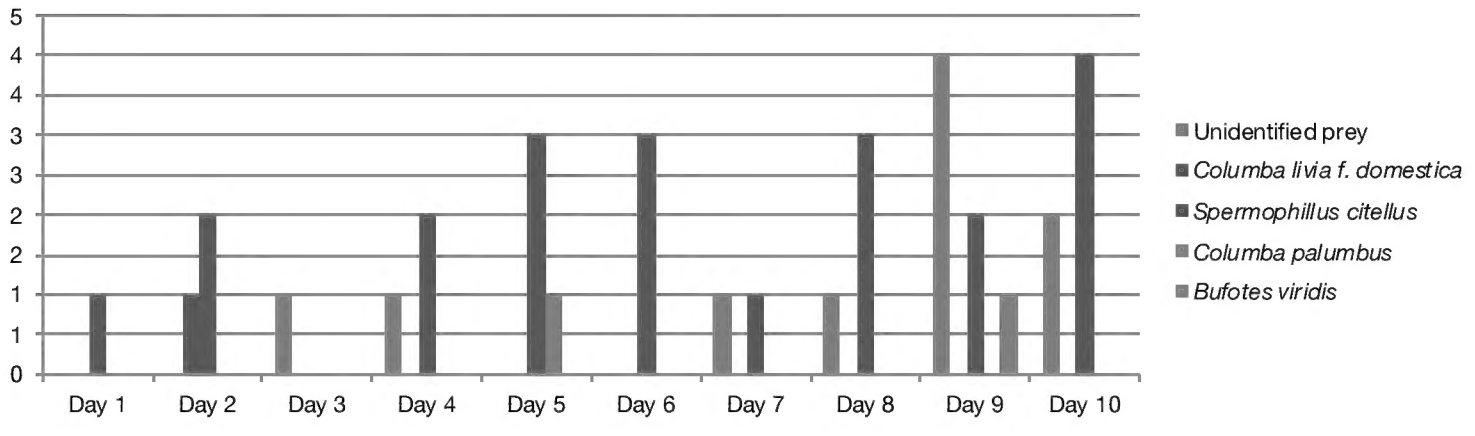

Figure 8. Proportion of prey species during the study.

Figure 9. Juvenile *Spermophilus citellus* brought to the nest as a prey (22.05.2022).

Figure 10. Maize (*Zea mays*) and peduculated oak (*Quercus robur*) used for the repellent activity of parasites (30.05.2022).

Figure 11. Common Wood Pigeon (*Columba palumbus)* brought to the nest (25.05.2022).

Figure 12. European Green Toad (*Bufotes viridis)* in the nest as a prey (29.05.2022).

Figure 13. Danger of suffocation with plastic material for a chick from the nest (right) (22.05.2022).

Figure 14. The female protecting the chicks during the storm (28.05.2022).

Figure 15. Spanish Sparrow (*Passer hispaniolensis)* in mutualism relationship with Long-Legged Buzzard (*Buteo rufinus*) (28.05.2022).

Figure 16. House Sparrow (*Passer domesticus)* in mutualism relationship with Long-Legged Buzzard (*Buteo rufinus*) (27.05.2022).

Discussion

According to published knowledge on the feeding ecology (Cramp and Simmons 1980; Alivizatos and Goutner 1997; Milchev 2009; Redinov 2010; Bakaloudis et al. 2012; Birău et al. 2018; Kassinis et al. 2022; Dravecký et al. 2023), mammals are the most abundant prey items in the diet of LLB from south-eastern Europe and Iran. In accordance with these published results, mammals 62% are the most dominant part of the diet of LLB in our study from south-western Romania.

An important component of the LLB diet is the Ground squirrels of the family Sciuridae. In Hungary, Bulgaria, and Romania the species consumed is *S. citellus* (Kalotás 1992; Milchev 2009; Danko 2012; Birău et al. 2018; Dravecky et al. 2023). In Ukraine, the species consumed is *S. suslicus*, *S. pygmaeus* and *S. odessanus* (Cramp and Simmons 1980; Syzhko 2005; Redinov 2010, 2012). According to published

results, *S. citellus* is the dominant part of the diet of LLB and in our study from south-western Romania.

Our study focused on detailed monitoring of both diurnal and nocturnal activity. The 34 preys were delivered to the nest with a peak of activity between 11:00–17:00 when 22 preys were delivered, including 14 European Ground Squirrels. During the 06–10 interval, 7 preys were delivered - including 1 European Ground Squirrel, and during the 18–20 interval, 5 preys were delivered - all European Ground Squirrels.

Our preliminary dietary data from the nest studied with the trail camera show that *S. citellus* was the most abundant, which can be explained by the short observation period coinciding with the appearance of juvenile European ground squirrels, which are easily preyed upon during these weeks as they are still very inexperienced. Of the total of 21 European Ground Squirrels brought to the nest as prey, 13 were juveniles. These were part of the diet on 9 out of 10 days of the study, with the exception of day 3. Day 3 was a rainy day, which explains the low activity of the European Ground Squirrels; during rainy periods, European Ground Squirrels retreat into their burrows (Spoelstra et al. 2000; Everts et al. 2004), and implicitly the possibility of being preyed upon decreases. The method has the advantage of being able to collect all data from the monitoring period, feeding frequency, and food consumption, aspects that could not be collected by other methods (pellets, prey remains, etc.). However, the method also has drawbacks, 10 prey items in our study (29%) could not be identified, which creates a large element of uncertainty in the correct assessment of the trophic spectrum, a problem encountered in other studies using camera traps to determine the diet of raptor species (Dravecký et al 2023). Sonerud (1992) mentions that no insects were observed to be carried to the nests, as these might provide less energy, which is below a certain threshold for the species. This aspect was also confirmed in our study, as no insect prey was observed during the study.

The short observation period may be one of the factors responsible for the low prey diversity, as evidenced by the remains of the European hare (*Lepus europaeus*) that appeared in the nest between the first hatch check (12 May) and the placement of the camera in the nest 10 days later (21 May). In addition, one of the parents was observed with a telescope carrying a Caspian Whipsnake (*Dolicophius caspius*) to the nest after the end of the recording period (5 June).

The size of open territories was significantly positively correlated with breeding success in this open-ground species (Friedemann et al. 2011). The pedunculate oak in which the monitored nest was located is in the open ground 180 m from the nearest access road. As there are several oak trees in the area (Fig. 2), we believe that the greater distance from the road compared to the other trees was the determining factor in the choice of the tree in which the nest was located. Tree-nesting large raptors have been highlighted in the past as species sensitive to human disturbance (Poirazidis et al. 2007; Martínez-Abraín et al. 2010).

In Romania, no research has been carried out on the diet or the incubation and development period of the chicks. The periods of registered nests with eggs and chicks comply from the end of March to mid-May reported for this species in Bulgaria

(Michev et al. 1984; Karaivanov 2000), the same period for Algeria (Djilal et al. 2023) and Cyprus with the last chicks flying on 15th of June (Kassinis 2009). The nestling period in Cyprus averages 32–34 days (Iezekiel et al. 2007), the confirmed period for the nest in our study. Vatev (1987) reported a period of about 49–53 days. The average clutch size is 3–4 (2–5) eggs (Glutz von Blotzheim et al. 1971; Cramp and Simmons 1980), more commonly 2–3 eggs (Mebs and Schmidt 2006), and one egg has been reported for two clutches (Milchev 2009). Our nest had 4 eggs with a 75% hatch rate. Plastic and textiles may be the reason that why one of the four eggs did not hatch because it was isolated from the others.

The LLB increasingly uses more artificial materials for nest lining without affecting the development of the chicks but the net of plastic fibers may cause brood abandonment because it hindered the incubation, the turning of the eggs, and the movements of the brooding bird in the nest (Milchev 2009; Milchev and Georgiev 2012). In our case, the artificial materials did not affect the development of the chicks, but the chicks were wrapped in plastic bags and photos show the possibility of suffocation. We also noticed the female added "green material" on the nest like maize leaves (*Z. mays*) and pedunculate oak (*Q. robur*). The literature mentions that it could have repellent activity and diminish nest ectoparasites (Wimberger 1984; Friedman et al. 2013).

Some raptor breeding populations may also be affected by adverse weather conditions during the breeding cycle (Kostrzewa 1989; Redpath et al. 2002; Ontiveros and Pleguezuelos 2003; Väli 2012). A study on LLB revealed a vulnerability in relation to precipitation during the warmest period, temperature seasonality, and annual mean temperature (Ştefănescu 2020). Other observations showed that the birds were particularly vulnerable when heavy rainfall occurred during incubation (Demerdzhiev 2022). According to our observations, the chicks were not at risk because the rainfall was short. On the third and fourth day, we observed heavy but brief rainfall when the mother was in the nest with the chicks (Fig. 14). Bad weather conditions reduce the hunting opportunities for the males and therefore the food supply for the chicks.

Trail camera monitoring of large raptor nests has also improved our understanding of interspecific interactions between predators and smaller bird species, such as the Spanish sparrow. Permanent nests, such as those of top predators, may also be used for breeding by some other species (Hansell 2000; Healy et al. 2008), and birds use the surroundings of these nests (Danko 2007). Maciorowski et al. (2020) confirmed the presence of birds in raptor nests in Poland, and Spanish sparrows have been observed in LLB nests in China (Hou and Wang 2023). Our observations confirmed the mutualism relationship in the Spanish sparrow, House Sparrow and LLB. The sparrows probably help in two ways: it strengthens the LLB nest and helps to eliminate parasites, a behaviour which was observed in other cases (Hou and Wang 2023). In that, the LLB gives it protection, not suspecting attacks on the sparrows, even if they were "accessible". However, no Spanish sparrow nests were found in the other 4 pedunculate oak in the area, suggesting that they deliberately chose to cohabitation with the LLB. Was also observed this habit in other LLB nests

in south-western Romania (Birău et al. 2018). Eighteen pairs of the Spanish Sparrow (*Passer hispaniolensis*) (Fig. 15) and one pair of the House Sparrow (*P. domesticus*) (Fig. 16) were observed in the same pedunculate oak. The nest of the House Sparrow and three nests of the Spanish Sparrow were built at the base of the nest of the LLB.

On 10 March 2023 the same parental pair LLB was seen around the nest and on the next visit on 29 April 2023 for further nest monitoring we observed a pair of Common Kestrels (*Falco tinnunculus* Linnaeus, 1758) occupying the nest in 2023. This change in nest site makes it difficult to monitor a pair over the long term, but also to clarify the composition of their diet. In addition, the removal of solitary trees from the agricultural landscape is a major threat in south-western Romania, affecting the breeding population of the LLB which, as in our case, nests on this type of support.

This study is the first to provide an increase in the level of knowledge of the diet composition and nesting behaviour of LLB in Romania, using research with a camera trail at the nest. Our results contributed to the knowledge of the basic components of the nesting behaviour and diet of this species. Our results, in agreement with other authors, confirm that the diet is represented mainly by mammals; *S. citellus* was the preferred food during the breeding period for Romania. The nest was located in an oak (*Q. robur*), in an agricultural landscape, 180 m from the road, in an agricultural plot. This highlights the importance of maintaining solitary trees in the agricultural landscape, which are important for LLB nesting. The nest contained both textile and plastic materials, highlighting the anthropogenic impact that can reduce breeding success. We found, for the first time in Romania, the existence of a cohabitation relationship between three species living in the same nest: LLB, Spanish Sparrow, and House Sparrow.

Acknowledgments

We are very grateful to Zsolt Hegyeli for the analysis of the images and for the suggestions offered in drafting the manuscript.

References

Adamian MS, Klem D (1999) Handbook of the Birds of Armenia. American University of 199 Armenia.

Ali S, Ripley DS (1968) Handbook of the Birds of India and Pakistan. Oxford University Press, Bombay.

Alivizatos H, Goutner V (1997) Feeding habits of the Long-legged Buzzard (*Buteo rufinus*) during breeding in northeastern Greece. Israel Journal of Zoology 43: 257e266.

Bakaloudis DE (2009) Implications for conservations of foraging sites selected by Short-toed Eagles (*Circaetus gallicus*) in Greece. Ornis Fennica 86(3): 89–96.

Bakaloudis DE (2010) Hunting strategies and foraging performance of the Short-toed Eagle in the Dadia-Lefkimi-Soufli National Park, NE Greece. Journal of Zoology 281: 167–174.

Bakaloudis DE, Iezekiel S, Vlachos CG, Bontzorlos VA, Papakosta MA, Birrer S (2012) Assessing bias in diet methods of the Long-legged Buzzard *Buteo rufinus*. Journal of Arid Environments 77: 59–65.

Baltag ES, Bolboaca LE, Ion C (2014) Long-legged Buzzard (Aves: *Buteo*) breeding population from Moldova region. European Scientific Journal 2: 346–351.

Birău A, Stănescu D, Nicolin AL (2018) *Buteo rufinus* (Cretzschmar, 1829), a nesting species in south-west Romania. Research Journal of Agricultural Science 50(4): 40–45.

Birrer S (2010) Synthesis of 312 studies on the diet of the Long-eared Owl *Asio otus*. Ardea 97: 615–624.

Cramp S, Simmons KEL (1980) The Birds of the Western Palearctic: Vol. II. Oxford University Press, Oxford.

Danko Š (2012) The long-legged buzzard (*Buteo rufinus*) in Slovakia in the past and present. Slovak Raptor Journal 6(1–1): 6.

Danko Š (2007) Conidification among Imperial Eagles (*Aquila heliaca*). Slovak Raptor Journal 1: 35–36.

Daróczi JS, Zeitz R (2008) The expansion of Long-legged Buzzard (*Buteo rufinus*) in Romania. Ornis Hungarica 15–16: 83–83.

del Hoyo J, Elliott A, Sargatal J (1994) Handbook of the Birds of the World. Vol. 2: New World Vultures to Guineafowl. Lynx Editions, Barcelona, Spain.

Demerdzhiev D (2022) Breeding parameters and factors influencing the reproduction of an expanding Long-legged Buzzard (*Buteo rufinus*) population under high breeding density conditions. Journal of Ornithology https://doi.org/10.1007/s10336-022-01967-4.

Djilali K, Sekour M, Rahma B, Souttou K (2023) First data on the breeding bio-ecology of the Long-legged Buzzard *Buteo rufinus* (Cretzschmar, 1927) in the Algerian Southwest (Taghit and El Bnoud).

Dravecký M, Shurulinkov P, Dilovski G, Revický M, Daskalova G, Obuch J (2022) Diet composition of the long-legged buzzard (*Buteo rufinus*) in southeastern Bulgaria. Raptor Journal 16(1): 1–15. https://doi.org/10.2478/srj-2022-0001.

Dravecký M, Shurulinkov P, Dilovski G, Revický M, Daskalova G, Obuch J (2023) Diet composition of the long-legged buzzard (*Buteo rufinus*) in southeastern Bulgaria. Raptor Journal. 16: 1–15. 10.2478/srj-2022-0001.

Everts LG, Strijkstra AM, Hut RA, Hoffmann IE, Millesi E (2004) Seasonal Variation in Daily Activity Patterns of Free-Ranging European Ground Squirrels (*Spermophilus citellus*). Chronobiology International 21(1): 57–71. doi:10.1081/cbi-120027982.

Fântână C, István K, Zoltán B, Szilárd D, Domșa C, Judit VS (2022) Atlas of bird species of community interest in Romania Second edition. Project co-financed from the European Regional Development Fund through the Large Infrastructure Operational Program 2014–2022. p. 154. [in Romanian].

Ferguson-Lees J, Christie DA (2001) Raptors of the World. Christopher Helm, London.

Friedemann G, Leshem Y, Bohrer G, Bar-Massada A, Izhaki I (2021) Long-legged buzzard *Buteo rufinus*. In: Migration Strategies of Birds of Prey in Western Palearctic. 262 Imprint CRC Press, p. 4.

Friedemann G, Yom-Tov Y, Motro U, Leshem Y (2010) Shift in nesting ground of the long-legged buzzard (*Buteo rufinus*) in Judea, Israel – An effect of habitat change. Biological Conservation 144(1): 402–406.

Friedemann G, Yom-Tov Y, Motro U, Leshem Y (2011) Shift in nesting ground of the long-legged buzzard (*Buteo rufinus*) in Judea, Israel — an effect of habitat change. Biological Conservation 144: 402–406.

Gong M, Ning Y, Han M, Zhao C, Tian J, Li L, Liu G (2019) A comparison of next-generation sequencing with clone sequencing in the diet analysis of Asian great bustard. Conservation Genetic Resources 11: 15–17. https://doi.org/10.1007/s12686-017-0952-5.

Graham RW (1992) Late Pleistocene faunal changes as a guide to understanding effects of greenhouse warming on the mammalian fauna of North America. In: Peters RL, Lovejoy TE (Eds) Global Warming and Biological Diversity. Yale University Press, New Haven, pp. 76–87.

Hansell M (2000) Bird Nests and Construction Behaviour. Hansell Cambridge University Press. Cambridge, United Kingdom. XI 1 288 pp. ISBN 0-521-46038-7.

Healy S, Walsh P, Hansell M (2008) Quick guides: Nest building by birds. Current Biology 18: 271–273.

Hou Y, Wang L (2023) Three species of birds in one nest. Frontiers in Ecology and the Environment. 21: 259–259. 10.1002/fee.2644.

Iezekiel S, Bakaloudis DE, Vlachos CG (2007) The Ecology and Management of the Long-legged Buzzard (*Buteo Rufinus*) in Cyprus. Report to the Research Promotion Foundation of Cyprus, Lefkosia.

Iezekiel S, Reuven Y, Dimitrios B, Christos V, Malamati P, Piotr T (2016) Breeding ecology of the Long-legged Buzzard (*Buteo rufinus*) in an increasing population on Cyprus. Journal of Arid Environments 135: 12–16. 10.1016/j.jaridenv.2016.08.007.

Jenkins A (1994) The influence of habitat on the distribution and abundance of peregrine and lanner falcons in South Africa. Ostrich 65: 281–290.

Kalotás Z (1992) Néhány adat a Hortobágyon vendégeskedo pusztai ölyvek (*Buteo rufinus*) táplálkozásához. Madártani tájékoztató 2, július– december: 43. [in Hungarian]

Karaivanov N (2000) New data on nesting birds in the region of the quarter Kremikovtzi. Ann. Univ. of Sofia "St. Kl. Ohridski" B.1-Zoology 91: 117–122.

Kassinis N (2009) Long-legged Buzzard *Buteo rufinus rufinus* breeding distribution and abundance in Cyprus. Avocetta 33: 75–78.

Kassinis NI, Tzirkalli E, Miltiadou M, Moysi M, Charalambidou I, Roulin A, Vogiatzakis IN (2022) Feeding ecology of the Long-legged Buzzard and diet overlap with sympatric Bonelli's Eagle in Cyprus. Journal of Raptor Research 56: 333–345.

Khaleghizadeh A, Sehhati-Sabet ME, Javidkar M, Adjami A (2005) On the diet of the Long-legged Buzzard, *Buteo rufinus*, in the Turan Biosphere Reserve, Semnan, Iran. Zoology in the Middle East 35(1): 104–105.

Klemm W, Kohl S (1988) Die Ornis Siebenbürgens, vol. III. Studia Transylvanica 8/III, Köln, Wien, 74 p. [in German]

Kostrzewa A (1989) The effect of weather on density and reproduction success in Honey Buzzards *Pernis apivorus*. In: B-U and Chancellor RD (Eds) Raptors in the modern world, Meyburg, WWGBP: Berlin, London & Paris, pp. 187–192.

Maciorowski G, Jankowiak Ł, Sparks TH, Polakowski M, Tryjanowski P (2020) Biodiversity hotspots at a small scale: the importance of eagles' nests to many other animals. Ecology 102(1). doi:10.1002/ecy.3220.

Mansoori J (2013) A Field Guide to the Birds of Iran. Tehran, Iran: Farzaneh Publication [in Persian]

Martínez-Abraín A, Oro D, Jiménez D, Stewart J, Pullin A (2010) A systematic review of the effect of recreational activities on nesting birds of prey. Basic and Applied Ecology 11: 312–319. 10.1016/j.baae.2009.12.011.

Mebs T, Schmidt D (2006) Die Greifvögel Europas, Nordafrikas und Vorderasiens: Biologie, Kennzeichen, Bestände. Franckh-Kosmos Verlag, Stuttgart.

Michev T, Vatev I, Simeonov P, Profirov L (1984) Distribution and nesting of the Long-legged Buzzard (*Buteo rufinus*) in Bulgaria. Ecologia 13: 74–82.

Milchev B (2009) Breeding biology of the Long-legged Buzzard *Buteo rufinus* in SE Bulgaria, nesting also in quarries. Avocetta 33: 25–32.

Milchev B, Georgiev V (2012) Plastic fibres cause a brood failure in a Long-legged Buzzard *Buteo rufinus* nest. Acrocephalus 32 (150/151): 211–212.

Mrlík V, Landsfeld B (2002) The occurrence of longlegged buzzard (*Buteo rufinus*) in parts of central Europe during 1980–1998 and possible factors for its recent expansion. Egretta 45: 104–114.

Newton I (1979) Population ecology of raptors. T. and A.D. Poyser, Berkhamsted

Newton I (1990) Birds of prey (Ed.). Weldon Owen Incorporation, New York, Oxford, Sydney.

Newton I (1988) Population regulation in peregrines: an overview. In: Cade TJ, Enderson JH, Thelander CG, White CM (Eds) Peregrine falcon population: their management and recovery. The Peregrine Fund, Boise, pp. 761–770.

Oehm J, Juen A, Nagiller K, Neuhauser S, Traugott M (2011) Molecular scatology: how to improve prey DNA detection success in avian faeces? Molecular Ecology Resources 11: 620–628. https://doi.org/10.1111/j.1755-0998.2011.03001.x.

Ontiveros D, Pleguezuelos JM (2003) Influence of climate on Bonelli's eagle's (*Hieraaetus fasciatus* V. 1822) breeding success through the Western Mediterranean. Journal of Biogeography 30(5): 755–760. doi:10.1046/j.1365-2699.2003.00860.x.

Paz U (1986) Plants and Animals of the Land of Israel: An Illustrate Encyclopedia. 6. Ministry of Defense and the Society for the Protection of Nature, Tel-Aviv [in Hebrew]

Poirazidis K, Goutner V, Tsachalidis E, Kati V (2007) Nesting habitat differentiation among four sympatric forest raptors in the Dadia National Park, Greece. Animal Biodiversity and Conservation 30: 131–145.

Redinov KA (2010) Ecology of the Long-legged Buzzard in Mykolaev region (South Ukraine). Berkut 19(1–2): 116–132.

Redinov KA (2012) Mammals in the diet of longlegged Buzzard (*Buteo rufinus*) in Ukraine. Праці Теріологічної школи 11: 120–129.

Redpath SM, Arroyo BE, Etheridge B, Leckie F, Bouwman K, Thirgood SJ (2002) Temperature and hen harrier productivity: from local mechanisms to geographical patterns. Ecography 25: 533–540.

Shirihai H (1996) The Birds of Israel. Academic Press, London.

Snow DW, Perrins CM (1998) The birds of the western palearctic, Concise. Oxford University Press, New York, 1832 pp.

Sonerud GA (1992) Functional-responses of birds of prey e biases due to the load size effect in central place foragers. Oikos 63: 223e232.

Spoelstra K, Strijkstra AM, Daan S (2000) Ground squirrel activity during the solar eclipse of August 11, 1999. Zeitschri für Saugetierkunde 65: 307–308.

Ştefănescu DM (2020) Sensitivity, Exposure, and Vulnerability to Climate Change of the Long-legged Buzzard *(Buteo rufinus)* in Europe. Forum geografic. Studii și cercetări de geografie și protecția mediului 21(2): 184–188. http://dx.doi.org/10.5775/fg.2020.083.d.

Stoychev S and Demerdzhiev D (2020) Long-legged Buzzard (*Buteo rufinus*). In: Keller V, Herrando S, Vorisek P et al. (Eds) European breeding Bird Atlas 2: distribution, abundance and change. European bird census. Councul & Lynx Edicions, Barcelona.

Syzhko V (2005) Materials on the breeding of Long legged Buzzard in Dnipropetrovsk region. Berkut 14(2): 272–273.

Tucker G and Heath M (1994) Birds in Europe: their conservation status. Cambridge, UK: BirdLife International (BirdLife Conservation Series no. 3).

Väli Ü (2012) Factors limiting reproductive performance and nestling sex ratio in the Lesser Spotted Eagle *Aquila pomarina* at the northern limit of its range: the impact of weather and prey abundance. Acta Ornithologica 47: 157–16.

Wang Q, Wang Z, Zheng K, Zhang P, Shen L, Chen W, Fan P, Zhang L (2022) Assessing the Diet of a Predator Using a DNA Metabarcoding Approach. Frontiers in Ecology and Evolution. Conservation and Restoration Ecology, Vol. 10. https://doi.org/10.3389/fevo.2022.902412.

Watson J (1997) The golden eagle. T. & A. D. Poyser, London.

Wightman C (2001) Patterns associated with habitat selection by peregrine falcons in central West Greelend. MSc thesis, Boise State University, Boise

Wu YQ, Ma M, Xu F, Ragyov D, Shergalin, J, Liu NF, Dixon A (2008) Breeding biology and diet of the long-legged buzzard (*Buteo rufinus*) in the eastern Jungar Basin of northwestern China. Journal of Raptor Research 42, 273e280.